THE TORNADO OF JUNE 6, 1906, NEAR LA CROSSE, WIS.

By G. A. Oberholzer, Local Forecaster.

The following account of this tornado is extracted from the author's Monthly Meteorological Report for June, 1906:

Wednesday, June 6, 1906.—Quite a severe thunderstorm came late in the afternoon; 0.56 inch of rain was measured. Most of the storm passed south of the station, in which quarter the clouds appeared very dark and threatening. It was learned later that a severe tornado passed about twelve miles south of the station.

The tornado was first observed in northeastern Iowa, near Burr Oak. Passing east-northeast near Reno, Minn., and Stoddard, Wis., where it crossed the Mississippi River, it was last observed in the town of Washington, La Crosse County, Wis., about two miles west of Portland. Its path curved slightly to the northward as it progressed, and was about fifty-five miles in length. It destroyed all buildings in its path, killed four persons and injured eighteen. The property loss was estimated at $70,000, exclusive of timber and crops, but the latter were not damaged to any great extent, because they were not far advanced. The tornado was characterized by many peculiar and violent phenomena usual to these storms. There was comparatively little electrical display, nor was the rainfall unusual. Its crossing the river near Stoddard was marked by well defined waterspout formation, and it destroyed a heavy wooden railway bridge across the Raccoon Creek nearby. Its action on the steep bluffs and in the deep ravines that mark the banks of the river was peculiar in that the windward or southwest exposures suffered far less damage, as shown by prostrated timber, than did the northeast slopes, where the full vorticular effect was very evident; whereas the southwest slopes, instead of showing trees thrown in all directions, as is usual, showed trees, with few exceptions, thrown to the left across the entire breadth of the track. Many of the trees on these southwest slopes were broken off ten to fifteen feet above the ground. Another peculiar feature was the decreased violence on the top of the bluffs, which are here about four hundred feet above the valley, and the immediate resumption of full destructive effect, not only in the deep ravines, but on the lee side of steepest declivities. Such destruction as occurred on the tops of steep hills crossed by the storm was most apparent on the farther edge, where trees invariably were thrown in the direction of the storm, probably caused by the air rushing toward the vortex when it had resumed full violence at lower levels. The path of the storm averaged about four hundred yards wide where its action could be determined in the timber. The vortex was quite distinct and regular, and, compared with the height of the bluffs which it crossed, seemed about eight hundred feet high, rapidly widening at the top. The vorticular motion was plainly discernible. Hail fell on the northwest side of the track. It took something less than two hours to travel its course.

NOTE ADDED JULY 21, 1906.

The morning weather map of June 6 showed a cyclonic area of unusual energy central over North Dakota, but the air circulation over Wisconsin, northeastern Iowa, and southwestern Minnesota continued to be influenced by what remained of a weak disturbance central in Wisconsin the day before.

At La Crosse the winds were two to three miles an hour, northerly during the morning, and the sky was cloudy; a light fog prevented an accurate observation of direction. At 11 a. m. the wind shifted to brisk southeast, and the temperature rose rapidly from 70° at 11:30 a. m. to 85° at 3:30 p. m., dispelling the fog and most of the stratus clouds. Cumulus clouds, moving from the southwest, prevailed up to 4 p. m.; no upper clouds were observed. After this time the sky became covered with heavy cumulus rolls moving from the southwest. By 5 p. m. a thunderstorm was observed in the south, spreading north and eastward. The clouds to the south were very dark, but in the west they were so light that the declining sun turned the entire western sky bright yellow up to 7 p. m. Thunder was heard from 5:07 to 8:15 p. m., and rain fell from 5:15 to 8:40 p. m. The wind rose to a maximum velocity of 25 miles an hour from the south at 5:45 p. m. Cloudiness continued all night. The hourly values of wind direction, taken from Form 1017, show no variation from the south to southeast currents that prevailed all the afternoon and night. The thundercloud was different from the usual form only in its boiling or rolling appearance, and in that it looked exceptionally threatening in its darkness, which was in marked contrast to the golden light that covered the west. Its movement was uniformly northeastward.

Steady southerly winds raised the mean temperature at La Crosse from 64° on the 2d to 74° on the 6th, and there was a steady increase in vapor tension from .402 to .575 inch in this period. The 6th was very oppressive. With the coming of the heavier clouds before the storm the temperature began to fall, from the maximum for the day, 85°, at 3:30 p. m., to 82° at 5:30 p. m. From this point it fell precipitately to 70° in half an hour. It rose to 74° after the storm, but again fell to 70° by 8 p. m. and remained near that point during the night. The barometer showed only a moderate thunderstorm effect.

The attempt to get sufficient reliable data to show the direction of the wind on both sides of the tornado track was discouraging, for the reports were vague and conflicting. The conclusion is that southerly winds prevailed throughout the day—southwesterly in eastern Iowa and southeasterly in southern Wisconsin. There is undoubted evidence from careful observers, however, that strong currents from the northwest existed within the tornado cloud; this cloud covered a territory, as far as can be ascertained, fully 20 miles wide. The testimony of men of intelligence indicated that there was a movement of two clouds, one from the southeast and the other from the northwest, that joined to form the tornado. This feature was observed particularly across the Mississippi River from Stoddard, at a distance of about three miles, as the funnel approached. A careful observer at Stoddard, who was about two thousand yards to the left of the storm's path, spoke of a sultry southeast wind preceding the passage of the tornado, shifting to a chill northwest current with hail, as the vortex came opposite and passed on, followed by warmer temperature after it had passed, attended by returning southerly winds. There is strong evidence along the entire track of the disturbance that the upward draught in the vortex was not strong. Of the buildings destroyed, the fragments were not carried forward to any unusual distance, but were found scattered within a few hundred yards. Trees in the track were found prostrated, with part of the roots intact.

The tornado formed, as nearly as can be ascertained, in northeastern Iowa at 4:30 p. m.; it crossed the Mississippi River near Stoddard at 5:40 p. m.; and was last seen in Wisconsin at about 6:30 p. m. The time of its passing Stoddard coincided with the time of the maximum wind velocity that occurred in the thunderstorm at La Crosse. Reports at various points to the southward of the storm's path confirm the opinion that the disturbance, of which the tornado was the culmination, covered a wide belt with general cloudiness, heavy rain and thunder, together with high winds, mostly from a southerly quarter.

From all the evidence that can be secured, there is much in favor of the theory that counteracting winds were the principal cause of the tornado, aided, to a less extent, by an upward draught through the extensive cloud area.

WEIGHTING FORECASTS.

To the Editor Monthly Weather Review:

Under the title "Forecasts and Verifications in Western Australia", in the Monthly Weather Review for January, 1906, you were good enough to publish a communication wherein I advocated a new departure in issuing weather forecasts. This was criticised by Professor Garriott, and his remarks indicate such a misconception of my meaning that I fear this must have been very badly expressed. Will you, therefore, kindly allow me to once more bring the matter forward, as I feel convinced that the principle is a good one?

I am suggesting simply this: that *one figure* should be added to each prediction to indicate, approximately, the weight or degree of probability which the forecaster himself attaches to that particular prediction.

I started with the figures 1, 2, 3, 4, 5, but experience has shown that three figures are sufficient. Thus, 3 might mean "almost certain to be verified", 2 would then stand for "normal probability", whatever that is in each state, and 1 for "doubtful".

I hope I have made my meaning clear this time. Instead of involving a great number of extra words, as Professor Garriott has taken it, only three or four extra figures would be required, sometimes only one. This disposes of his remarks (1), (2), and (3). As to (4), when he says "the bewildering complication of uncertainties it involves would confuse even the patient interpolator", it will now be seen that no confusion whatever is introduced, but quite the opposite. If a forecast is to be of any practical value, each item must be considered separately, and all I propose to do is to tell the farmer, etc., by means of a simple figure just what amount of confidence he may place upon the prediction he is considering. In (5) Professor Garriott says: "Our public insist upon having our forecasts expressed concisely and in unequivocal terms". I am glad to hear it. It shows how well the Bureau has educated its public, and I look forward to the time when the Australian public will also thus insist. Meanwhile, I am trying to "express my forecasts concisely and in unequivocal terms", whether the public wants it just yet or not, but quite fail to see how the weighting interferes with this. Indeed I think it assists greatly. In the sister science, astronomy, a weighted observation is regarded as conveying more precise information and being of greater value in combination with other similar observations than one about whose probable error no information is given. I do not propose to interfere in the slightest with the language in which a forecast is expressed, but only to add a figure at the end to signify its weight or degree of probability.

May I request that this principle be considered and criticised? Look for a moment at the results I have obtained. During the year 1905 I attached the figure 5 (maximum weight) to 685 definite predictions, and of these 675 proved to be correct. I issued 970 with the figure 4 (normal probability), of which 910 were correct; and I issued 296 with weight 3 (doubtful), of which 233 were verified.

Now this is the point I wish to make clear. Those forecasts which were marked "doubtful" were the *best I could frame* under the circumstances. I could see no way of improving them at the time, and they would not have been expressed differently whether I weighted them or not. If I make no distinction between these and others, I degrade the whole. But if, on the other hand, I attach a figure which practically says "I'm sorry, but this is the best I can do for you to-day—do not attach too much importance to it", I eliminate beforehand the adverse opinion which a great number of incorrect forecasts must produce, and I raise the bulk of the predictions to their true value. In particular, I create a series, marked with the maximum figure, which the public finds to be almost invariably correct, and thus raise the value of this particular series enormously.

(Signed) W. ERNEST COOKE,
Government Astronomer for Western Australia.
THE OBSERVATORY, PERTH, WESTERN AUSTRALIA, *June 7, 1906.*

MONTHLY REVIEW OF THE PROGRESS OF CLIMATOLOGY THROUGHOUT THE WORLD.

By C. FITZHUGH TALMAN, U. S. Weather Bureau.

CLIMATE OF ALASKA.

This is the subject of a recent monograph by Dr. Cleveland Abbe, jr. (written partly in collaboration with Alfred H. Brooks), which forms a part of Professional Paper No. 45, of the U. S. Geological Survey (Washington, 1906).

Alaska has been the field of energetic exploration by the Geological Survey since 1898; whence our knowledge of its topography and geology has grown at a rapid rate. At the same time there has been a great influx of settlers, attracted by both the agricultural and the mineral resources of the country; and thus the climatological service of the Weather Bureau has been able to recruit observers at many places which, until recently, had no civilized inhabitants. It is mainly the material collected during the last thirty years by the Signal Service and the Weather Bureau that Doctor Abbe summarizes in his paper; which, therefore, supplements the well-known memoir of Doctor Dall,[1] in which were brought together all data available up to 1877.

Comparing Doctor Abbe's paper with the earlier literature of the subject, we find a new subdivision of the territory into eight climatic provinces, each susceptible of very satisfactory generalized description. Regarding each of these regions much fresh information is afforded, some of which corrects impressions heretofore prevailing regarding extreme conditions of temperature and rainfall. Thus, the maximum temperature recorded by properly sheltered instruments has not risen above 90° in the great Yukon basin, while the temperature of 94° at Copper Center, on the Copper River plateau, is the highest that has been reported from any of the voluntary observing stations of the Weather Bureau in Alaska. Earlier writers have spoken of temperatures as high as 112°, or even 120°. The lowest recorded temperature is —80° at Fort Reliance, in January. The heaviest annual precipitation, 190.09 inches, occurs at Nuchek (Fort Constantine). The greatest rainfall in twenty-four hours was 7.41 inches, at Orca, on Prince William Sound, a record which has been exceeded at many stations in other portions of the United States. The greatest number of rainy days (i. e., days with .01 inch, or more, of precipitation) is 250.8 at Unalaska, while Sitka, which was formerly considered the rainiest point in the United States, has but 207.9.

Of great practical interest to intending settlers in Alaska are the statistics given in this paper regarding the length of the growing season at the various stations, and the dates of the opening and closing of rivers and harbors.

"SCHEITELWERTE."

One feature of Doctor Abbe's memoir above cited deserving of special mention is the introduction of tables exhibiting the "Scheitelwerte", or most frequently recurring values of certain climatic elements, at stations for which long records are available. The fact that the "Scheitelwerte" often depart widely from the arithmetical means of a series of meteorological measurements, or values, was first brought into prominence by Dr. Hugo Meyer, in his "Anleitung zur Bearbeitung meteorologischer Beobachtungen für die Klimatologie" (Berlin, 1891), though the idea had previously been applied, in climatic tables, to the discussion of wind direction—the prevailing, or most frequent direction, having been given an even more prominent place than the resultant or mean direction—and had occasionally been applied to the other elements. The question of introducing frequency values into climatic tables was discussed at the Munich Conference, but no very definite conclusion was reached as to the extent to which this should be done.

There can be no doubt that, for many parts of the world, "Scheitelwerte" of the temperature, precipitation, etc., give a truer picture of the climate than the mean, or so-called normal values, though the latter can by no means be dispensed with. "Scheitelwerte" represent the values we are most likely to encounter; but the arithmetical means are a factor of the sum total of the element for the whole period of observation, and for many scientific purposes this is the more important datum.

As the literature of "Scheitelwerte" is nearly all in German

[1] United States. Coast and Geodetic Survey. Pacific coast pilot. Coasts and islands of Alaska. Washington, 1879. Appendix 1. Meteorology. W. H. Dall.